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TAMING THE HUMID TROPICS
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Tomorrow's Tropical Bounty

Experts disagree about whether the humid tropics—a region of seemingly lush abundance—can be exploited to help feed the world's burgeoning population.

Some observers all but dismiss most of this region as potential farm land. They contend that nutrients are limited and concentrated in the vegetation. This low level of fertility is maintained by a rapid and efficient recycling of mineral nutrients under a canopy that shields the soil from driving rain and searing sun. Expose the soil to open cultivation, these experts say, and it is doomed. The heavy rains and heat soon leach nutrients and oxidize organic matter.

Other scientists are optimistic. They argue that the tropics, like the temperate regions, are too varied for broad generalizations. For example, even with little organic matter, record yields have been obtained with proper fertilization, water control, and soil management. And while most soils in the humid tropics are infertile, modern agriculture rarely relies on natural fertility.

Indeed, present agricultural technology and management can make sizeable portions of the humid tropics arable. In the Philippines, for example, scientists have grown as many as five crops in a year. And the intensive management systems developed by ARS scientists in Puerto Rico provide further evidence of what today's technology can achieve (p. 8).

But a concerted research effort must get underway before the humid tropics can grow food in abundance. This effort would benefit from a thorough review of research on tropical agriculture conducted over several decades by former colonial powers; much of this research is unread. Then more regional research centers—there are only a few—need to be established in ecological zones. Since vast areas of the tropics have similar soils and climates, research findings could be widely adapted. A high priority research need is the breeding of locally adapted crops that respond to chemical fertilizers.

Science can help harness the resources of the humid tropics, a region of favorable rainfall, sunlight, and temperature and where plants grow without respite the year around. Despite problems, these advantages are too important to ignore in the race between the stork and the plow.

Editor: R. P. Kaniuka
Managing Editor: E. H. Davis
Contributors to this issue:
R. C. Bjork, V. R. Bourdette, J. P. Dean, M. B. Heppner, L. W. Lindemer, D. P. Movitz, S. A. Oring

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Orville L. Freeman, Secretary
U.S. Department of Agriculture

G. W. Irving, Jr., Administrator
Agricultural Research Service

Working model... a key to preventing

Reproductive Failures

Brinsfield and laboratory technician D. K. Higginbotham begin surgical technique used to observe rippling in a uterus of a live ewe. In foreground is the camera that records the progress of each ripple (ST–4223–6).

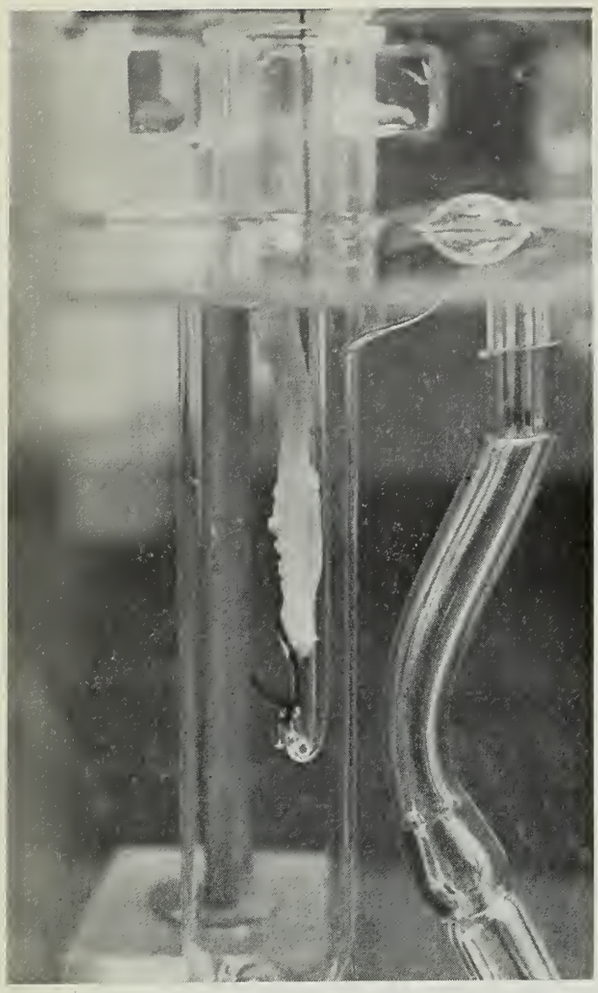
A NEW WORKING MODEL of reproductive diseases for research studies will speed development of better treatments for infertility.

The model is created by a small plastic spiral inserted into the uterus of females—the same device now widely used as a contraceptive. Scientists trying to find the processes affected by the spiral are perplexed by the fact that different animals react in different ways, depending on the species and the time and exact location of the implant.

But this cloud of perplexity has a big silver lining, since by selecting the proper animal, timing, and location, scientists can duplicate all major types of infertility by simply inserting a spiral. This method gets around the problem of studying infertility with surgery or hormone treatments which alter the function under study, thus making results hard to interpret.

One reproductive problem is interference with sperm traveling toward an unfertilized egg. Some time ago, ARS research showed that spirals interfere with sperm travel through the uterus of a sheep (AGR. RES., Jan., 1966, p. 4). Now, followup studies by physiologist T. H. Brinsfield show that the interference is due in part to unnatural rippling in the uterine wall.

Sperm travel inward by riding



Closeup of a strip of uterine wall preserved in tissue-organ bath, which protects and nourishes the tissue. Top of the tissue is connected with a thread to the recording lever; bottom is tied to a tube that bubbles oxygen past the tissue. The strip is immersed in a nutrient solution, and the tube holding the nutrient solution is set in a water chamber that keeps the test sample at the body temperature of sheep, 102° F. (ST–4222–6).

these uterine ripples, and Brinsfield first postulated that the spiral might stop or reduce the waves. He set up a laboratory rig including strips of uterine wall with or without spirals, and found that both strips rippled with equal force and frequency.

Confirmation that ripples were strong came from work by physiologist J. W. Warren, who works in a lab next to Brinsfield. He found that various combinations of drugs that accelerate rippling in the uterus failed to overcome the contraceptive effect of spirals implanted in sheep.

Apparently, the only way to find the answer was to observe rippling of a live uterus in its normal environment. Brinsfield worked out a surgical technique to do so and found that the direction of rippling was reversed in implanted sheep as compared to unimplanted sheep. This meant that sperm riding the ripples would move toward the outside of the body of an implanted sheep, instead of toward the inside where the unfertilized egg is located.

This was not the whole story. H. W. Hawk, another ARS physiologist, noted that sperm taken from implanted sheep uteri were often broken at the juncture of head and neck. Precise measurements showed that only 12 percent of the sperm introduced into an implanted uteri could be recovered intact after 5 hours, compared to 40 percent with the unimplanted uteri.

Hawk thinks that the presence of one foreign body in the uterus (in this case the spiral) heightens the reaction of the uterine tissues against another foreign body (in this case the sperm). A normal uterus kills some sperm, but an irritated uterus kills more, he believes.

ARS physiologists think their findings about a sperm's troubles in traversing an implanted uterus may help clarify several unexplained types of infertility. For example, experimental hormone treatments to synchronize the estrous cycle of farm animals have depressed fertility, possibly because the hormonal changes made the uterus hyperactive against sperm.

Another example is infertility common for a month or two after a female has given birth. The ripples necessary for sperm transport may not have resumed their normal force and direction, ARS scientists think.■

Brinsfield observes rippling in a section of uterine wall. The coils, which show prominently, replenish the nutrient solution feeding the tissue. The instrument shown is a kymograph, designed to measure contractions in smooth muscles (ST–4222–2).

ERRANT DDT MOLECULE

A slight structural variant in commercial DDT may be the culprit of suspected hatching problems in wild birds

THE STANDARD DDT MOLECULE has a chlorine atom at the far end of each of its two benzene rings. But about 20 percent of commercial-grade DDT consists of a variant form, called an isomer, that has one of the chlorine atoms in the molecule shifted from the end to the top of one of the benzene rings.

Chemists say that this isomer, ortho-para DDT, is incidental to the DDT manufacturing process. If evidence is found that the isomer actually does depress hatch of birds, it could be eliminated from commercial DDT by a fairly simple change in manufacturing. The change would not impair the pesticide's effectiveness.

ARS researchers discovered the isomer in 1944 while developing DDT as a pesticide. Scientists only recently began to suspect, however, that the isomer might be more active than standard DDT as an estrogenic agent, says ARS biochemist Joel Bitman.

Estrogenic agents mimic the action of natural estrogen, a hormone basic to growth and function of female reproductive structures. To measure estrogenic activity of a compound, scientists monitor the content of glycogen, water, and RNA in the uterus of a test animal exposed to the compound. These indicators rise in response to estrogens.

In tests with rats at Beltsville, Md., Bitman found that these indicators also rise in response to pure ortho-para DDT. Rats given pure standard DDT did not show estrogenic response.

Tests were then transferred to birds. Wildlife researchers have determined that a number of wild bird species carry considerable DDT residues in their bodies. These residues were implicated as a probable cause of decreased hatchability of eggs from several bird species.

When Bitman gave Cornish hens and Japanese quail ortho-para DDT, reactions in reproductive tissues were similar to those caused by a typical estrogen. This led him to suspect that the isomer might interfere with normal reproductive processes such as egg production. Whether this connection actually exists remains to be proven.

Biologist H. C. Cecil feeds ortho-para DDT in oil solution to Japanese quail (ST–4221–14).

Tests are now underway to test hatchability of eggs and development of reproductive structures in chickens after exposure to pure ortho-para DDT. Physiological tests on rats are also in progress.

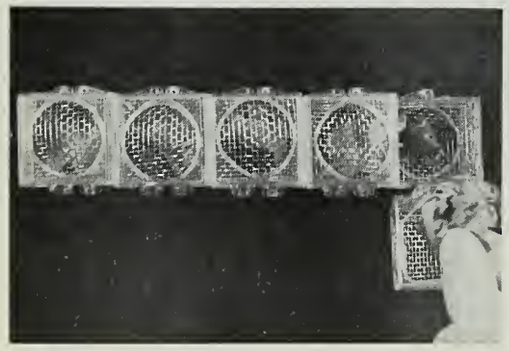
ARS studies on body uptake of ortho-para DDT have shown that it accumulates no faster in chickens than standard DDT. In rats, the isomer accumulates more slowly.

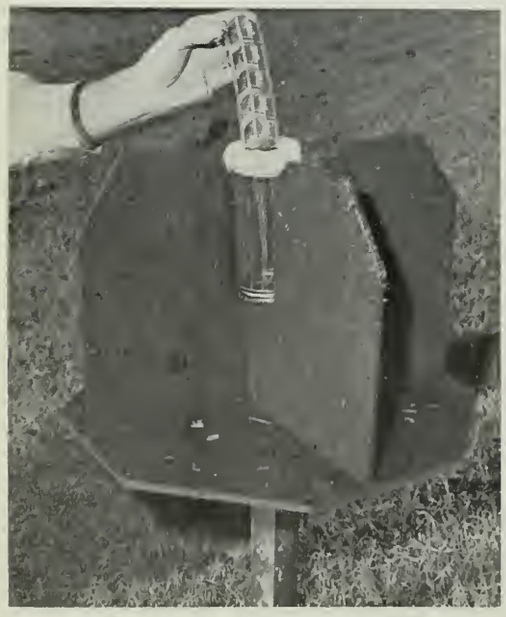
At present, field pesticide surveys do not distinguish between standard and isomer DDT. Bitman thinks, however, that less isomer accumulates in the plant-animal food chain than standard DDT because the isomer constitutes only about 20 percent of the total DDT contamination and, on the average, individual units in the food chain retain proportionally less isomer than standard DDT.

A change in survey procedure will clarify how widespread the isomer actually is.■

MALE SIGNALS

Draw Weevils to Cotton Fields





Above: D. D. Hardee changes males in pyramid trap used to test overwintered boll weevils (PN–1725). ***Left:*** *Males are fed fresh cotton squares just before shipment in five-unit box that houses boll weevils in traps (PN–1726).* ***Lower left:*** *Wing trap coated with adhesive contains male weevils as source of pheromone (PN–1727).*

BOLL WEEVILS are drawn to cotton more by male weevils than by any attractant the plant itself may have.

This recent research finding suggests that traps baited with male weevils, or with a male attractant (pheromone) yet to be isolated, may help in detecting and suppressing infestations.

Over the past 75 years the boll weevil has spread from Southern Texas to the Atlantic and is now threatening cotton as far west as California. Boll weevils migrate in search of food and propagation sites in the spring, as they come out of hibernation, and in the fall, as an exploding weevil population in untreated or poorly treated cotton fields forces the insects to look for fresh food supplies.

According to entomologists D. D. Hardee, W. H. Cross, and E. B. Mitchell, State College, Miss., an "advance guard" of migrating weevils finds uninfested cotton fields by chance or because of a short-range response to a plant attractant. The males then emit a windborne pheromone that draws other male and female weevils to the field. This pheromone is so powerful that in tests with *Anthonomus grandis* Boheman weevils, the weevils preferred male weevils over uninfested cotton plants 25 to 1.

The scientists believe that using male weevils or their pheromone in traps or some other way could replace or supplement less sensitive and more laborious surveying methods, especially in lightly infested fields. They also suggest that putting insecticides into such traps offers considerable promise in suppressing weevil populations. Their work, however, is still experimental.■

Insecticide Vapor

More effective than sprays for stored foods

Technician Gerald Eason examines the original vapor generator which he helped develop at the Savanna, Ga., laboratory. The generator is in operating position (PN–1728).

An ARS-developed generator for dispensing vaporized dichlorvos insecticide could increase the safety and effectiveness of protecting stored food from insect infestation.

The generated dichlorvos vapor is diffused more uniformly and remains suspended in the air longer than other insecticides applied as residual or aerosol sprays. The vapor technique may therefore leave less residue. Researchers add that the method could also prove less costly than other techniques.

Dichlorvos, an organic phosphorus insecticide, was recently approved by the Food and Drug Administration for use on bagged or packaged food in storage, but has not yet been registered for this use by USDA. It is effective in minute amounts, dissipates rapidly, and leaves no long-lasting residue.

Dichlorvos is particularly suited for use in a vapor generator because it is highly active in the vapor form. If applied about once a week, dichlorvos vapor can protect any susceptible commodity against infestation by a wide variety of insects. It does not penetrate the commodity, but kills exposed insects before they have a chance to start an infestation.

Operating the generator as directed involves virtually no risk to humans. The machine can do its work during the night while no one is in the warehouse. The dichlorvos will aerate out in 4 to 6 hours after the 6-hour treatment period.

The generator is easy to operate and could be built for a moderate price. A fan blows heated air through insecticide pellets, and the insecticide vapor is carried into the air. Once set up, the machine can operate unattended.

A market quality research team in Savannah, Ga., invented and tested the prototype generator in response to a request by the Armed Forces for help in protecting food stored over extended periods. Although the generators are not yet being produced commercially, the Armed Forces plan to use them in some of their huge supply warehouses, once USDA registration has been obtained.

The machine's developers foresee that, after a minimum of additional research, the dichlorvos generator could be used in mills and processing plants as well as in warhouses.■

Despite obstacles, agricultural science is making significant headway toward

TAMING THE HUMID TROPICS

A VIRTUALLY UNTAPPED 2 billion acres of land—almost as much as the entire United States—awaits development to help feed the world's exploding population.

That land—the hot, humid tropics of Central and South America and the Caribbean islands—needs agricultural research to make it prosper, says ARS soil scientist Jose Vicente-Chandler. Vicente-Chandler is leader of soil and water conservation research in cooperation with the Agricultural Experiment Station of the University of Puerto Rico, Rio Piedras.

Some observers in tropical America, especially in areas below 3,000 feet elevation with plenty of well-distributed rainfall, think that bountiful harvests are available at the drop of a seed. Others conclude that the verdant growth is an illusion, that all one can do is clear small areas and grow a crop or two, then abandon these areas until nature has rebuilt the soil. They speak of soils that turn to stone, of "all-important" organic matter burning up at the first touch of sunlight, and of soils devoid of nutrients.

Neither of these outlooks, says Vicente-Chandler, is correct.

Modern agriculture *can* cope with many of the problems of tropical agriculture (see p. 2). Even so, only a complete system of intensive management practices for varying crops and soils can make full use of the region's tremendous potential.

In Puerto Rico, Vicente-Chandler and his ARS colleagues have already developed intensive management practices for coffee which have increased production from 150 pounds per acre to more than a ton in some instances. These practices include:

- Using superior, high-yielding varieties.
- Spacing trees closely in contour rows with a cover crop between rows to restrict erosion.
- Growing trees in strong, unshaded sunlight instead of under shade trees. the traditional practice, which robs coffee trees of light, moisture, and nutrients.
- Fertilizing trees heavily with nitrogen and potash, and applying lime and minor elements as required.
- Spraying the trees periodically to control insects and diseases.
- Developing a 7- to 10-year pruning cycle based on a new system of two-step pruning (AGR. RES., Apr. 1968, p. 15).
- Processing coffee carefully with modern equipment to avoid damaging beans and lowering market price.

Vicente-Chandler emphasizes that all of the practices must be coordinated to get the desired results.

Coffee isn't the only crop to benefit from new management practices. Yields of yams—a dietary staple in the tropics—have exceeded 26 tons per acre through management systems developed by ARS and the Puerto Rico Station. The scientists credit four practices used in combination for lifting yields above the usual 18 tons per acre harvested by local farmers:

- Increasing plant populations from 4,370 to 10,890 per acre.
- Spacing plants on the square (2 feet by 2 feet) to cut down competition for nutrients.
- Supporting plants with 6-foot stakes to encourage vine growth and increase tuber size.
- Raising seed beds about 10 inches to reduce drainage problems.

The ARS scientists found that the over-all increase resulted almost exclusively from larger yams in the staked plots. Numbers of yams grown followed planting rates closely.

The researchers, ARS agronomist Ruben Caro-Costas, and Commonwealth research assistant Elvin Boneta along with ARS agricultural technician Servando Silva, used Guinea Blanco variety yams in the experiments conducted near Orocovis and Adjuntas, Puerto Rico.

In other research, scientists developed intensive management systems for high-yielding Pangola grass pastures. They carried more than two head of cattle per acre throughout the year, a hopeful development where animal protein is relatively scarce. More than 1,000 pounds of beef can be produced per acre annually on highly eroded soils with 50 percent slopes.

Many problems—technical, economic, and social—remain to be worked out, however, before tropical America's agricultural potential can be fully realized.■

Far left: *Puerto Rico's mountain region (PN–1729).* ***Top:*** *Pot extraction studies show which soils have high or low potassium-supplying power and, hence, when savings in fertilization are possible (PN–1730).* ***Above:*** *Intensively managed Pangola grass pasture carried more than two head of cattle per acre and protected this steep slope from erosion (PN–1731).* ***Left:*** *Higher yields came from larger yams. Yams were misshapen but shape does not affect price (PN–1732).*

Kerosene Carrier

Regulates Herbicide Persistence

HERBICIDES with tailor-made residual action may be just around the corner.

EPTC and R–1870, applied in water at 40 gallons per acre persist more than 5 weeks, but ARS researchers have learned that substituting kerosene for water as the carrier or solvent can cut the persistence to 2 weeks.

The persistence of present herbicides, applied in carriers composed mostly or entirely of water, is difficult, if not impossible to control. But regulating this persistence is of great concern in producing horticultural crops. Often the problem is ridding the soil of a herbicide once it has performed its function. In other situations, long-term residual action may be desired.

ARS plant physiologists L. L. Danielson and W. A. Gentner, Beltsville, Md., tested a number of chemical and petroleum products as carriers for several phenyl and thio carbamate herbicides. They formulated these in acetone, benzene, xylene, fuel oil, and kerosene solvents and compared them with the commercially prepared herbicides.

None of the solvents affected the persistence of CIPC, IPC and CDEC herbicides tested. Persistence of EPTC and R–1870 applied in acetone, benzene and xylene at 40 gallons per acre was the same as when water was the carrier.

But with a kerosene carrier, persistence of EPTC and R–1870 increased as the volume of kerosene decreased and vice versa. Applications of 40 gallons per acre persisted 2 weeks whereas 10 lasted 5 weeks. Applications exceeding 40 gallons produced no additional decrease in the residual action of the herbicides.

Used as a herbicide carrier, kerosene does cost more than water, but it is still relatively inexpensive for this purpose, and its regulator ability would offset the cost appreciably.■

Gentner (right) and technician C. W. Spence check growth rates of ryegrass in greenhouse flats. Ryegrass is used as a bioassay plant to determine the dissipation rate of chemicals in soils. Ryegrass will not grow if too much chemical is present, but as the chemical dissipates, the ryegrass grows (ST–4358–16)

AMMONIA:
a control for Root Rot

HAPPINESS to many Pacific Northwest farmers is finding a deterrent for *Fusarium* root or foot rot in cereal crops.

ARS soil scientist R. W. Smiley, Pullman, Wash., may have found one answer in anhydrous ammonia.

Root or foot rot is caused by the fungus *Fusarium roseum* which infects small grain crops, decreasing yields. Winter wheat yields for example, have been lowered as much as 50 percent by the fungus. *Fusarium* spores inhabit the surface 4 to 6 inches of soil.

At present, there is no adequate control of the disease. Chemical control has been erratic, ineffective, and economically prohibitive. Commercial grain varieties with tolerance or resistance are not yet available.

Meanwhile, ARS scientists tried anhydrous ammonia. In laboratory studies, they found that the fungus population in soil was drastically reduced in the 3 inches surrounding the site of application, called the ammonia retention zone.

Seven days after the ammonia injection, spores were undetected in the center of the zone, and after 14 days could not be found in the peripheral region. Furthermore, spores did not appear after 225 days of incubation.

After injection into soil, ammonia turns to ammonium, and from there to nitrite and nitrate. Tests indicated that an accumulation of as little as 10 parts per million of nitrite may reduce the viability of *Fusarium* spores—and that they are completely undetectable if exposed to more than 32 ppm nitrite.

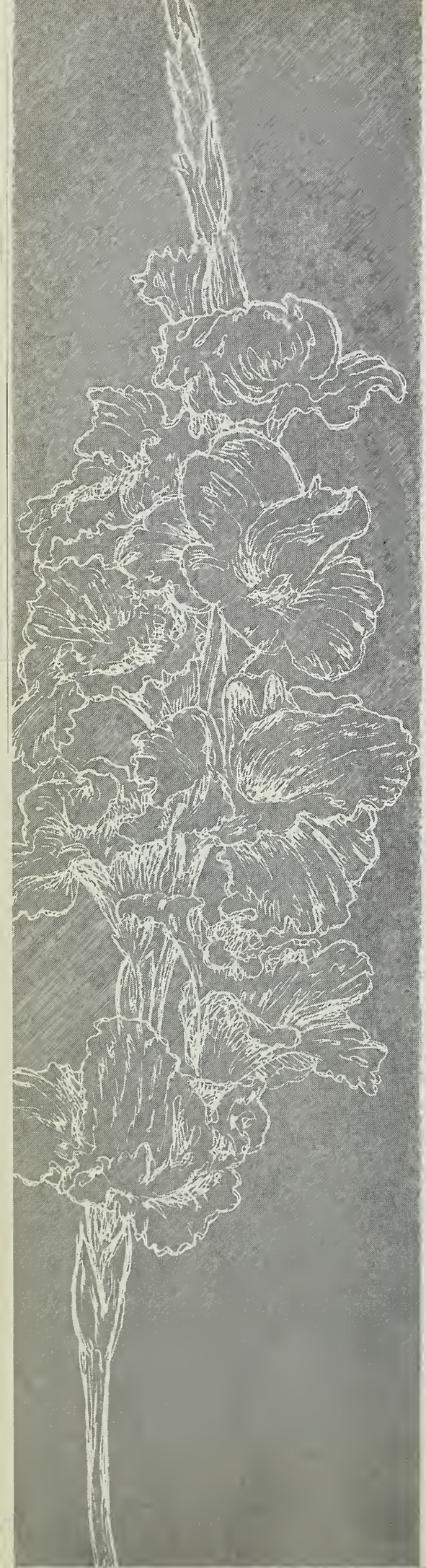
This toxic effect, observed in the laboratory and in the field, may be due to gaseous ammonia, high nitrite accumulation, or both. In addition, *Fusarium* species causing pea foot rot and other diseases were affected the same way.

Smiley, plant pathologist R. J. Cook, and soil scientist R. I. Papendick think that compounds other than anhydrous ammonia may also display fungicidal properties. They are looking for those containing free ammonia or those liberating free ammonia when breaking down in soil.

The Pullman study, conducted in cooperation with the Washington College of Agriculture Research Center, is continuing work to determine the feasibility of using anhydrous ammonia in foot rot control.■

Smiley operates an anhydrous ammonia applicator which he designed for field injections of ammonia (PN–1733).

Liquid anhydrous ammonia is injected into cans of soil to study the effect of ammonia on Fusarium spores. The apparatus was designed specifically for this use (PN–1734).



Holding Solutions promise Longer-Lasting Gladiolus

STUDIES OF AN EFFECTIVE holding solution for fresh-cut gladiolus are helping solve the mystery of how such preservatives do their job.

Research on preserving gladiolus has provided information on storage temperatures and handling techniques. But such procedures, if used ineffectively, may shorten vase life. Holding solutions, therefore, could be valuable supplements for florist and consumer use and might help overcome the effects of poor handling techniques. In addition, an understanding of how a preservative works may make it possible to develop more effective preservatives for all flowers.

ARS horticulturist F. J. Marousky, working in Bradenton, Fla., found that a holding solution of quinoline salts (8-hydroxyquinoline citrate) and sucrose can double vase life and improve the quality of fresh-cut gladiolus.

Improving the water-absorbing ability of fresh flowers is a key to lengthening their vase life. Some scientists who have successfully employed a quinoline salt-sucrose solution with other types of fresh flowers believe that the salts work by killing the stem-clogging bacteria associated with the sucrose. This action would allow the flower to absorb more water through the tiny vessels in its stem.

Other scientists, including Marousky, feel that vascular blockage is due less to bacterial contamination than to natural causes. His data supports the theory that quinoline salts not only disinfect the stem but also reduce natural stem blockage. The action of the salts in reducing natural stem blockage is not yet fully understood.

Another key to longer vase life is improving the ability of the flowers to retain water. Marousky's findings give weight to the theory that both sucrose and quinoline salts close stomata—tiny openings in the leaves through which the plant loses water.

Although sucrose itself limits water absorption in flowers, its role in closing stomata and in supplementing depleted nutrients makes it an essential part of the solution.

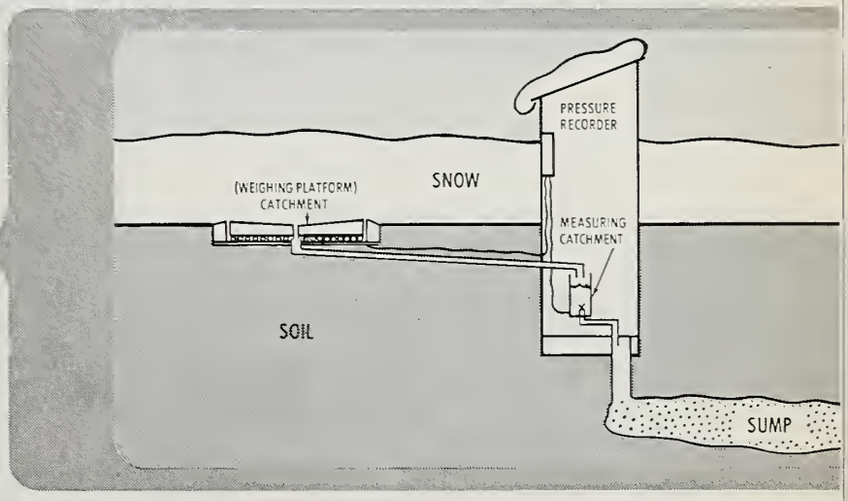
In Marousky's test of holding solutions, White Friendship gladiolus held in water reached their maximum fresh weight (a measure of water absorption and retention) 1 day after cutting and reached their maximum length within 3 days.

Gladiolus held in preservative solution did not reach maximum fresh weight until the fourth day after cutting and continued to elongate for 5 days. The spikes produced more and larger opened florets than those in water, and Marousky found that the solution retarded stem wilt for several days.

The flowers were kept under continuous fluorescent light in a 74° F. laboratory.■

Left: Field installation of the standard 12-foot snow pillow and the surface precipitation gage with 5-foot weighing platform. Recorder house and dual precipitation gages are in background (PN–1735). ***Below:*** *Diagram of new gage. Pressure gage weighs snow on platform; snowmelt drains into tank to be recorded by another gage (PN–1736).*

one gage measures rain, snow, snowmelt



THE NEED for a single instrument to measure rain, snow, and changes in snowpack water by evaporation, condensation, or melting may have been satisfied by ARS scientists at Boise, Idaho.

The new instrument, called the surface precipitation gage, was designed to provide more accurate information for water studies and flood forecasts than present methods. One such method employs snow "pillows" 12 feet in diameter which activate a pressure gage that responds directly to the weight of the snow and provides a continuous measure of water content. The pillows are satisfactory for weighing snowfall but do not measure snowmelt or evaporation and consequently cannot provide an accurate record of how much water actually reaches the soil.

The new gage, however, can weigh snowfall, measure snowmelt—and by interpolation, evaporation—and it accurately records rainfall.

The gage has three major components: a hydraulic weighing platform collector, a measuring catchment, and a pressure-recording system.

The hydraulic weighing platform, 5 feet in diameter, is made of lightweight concrete and rests on a liquid-filled (water and alcohol) 100-foot-coil of butyl tubing. The tubing connects with a pressure gage that records snow weight.

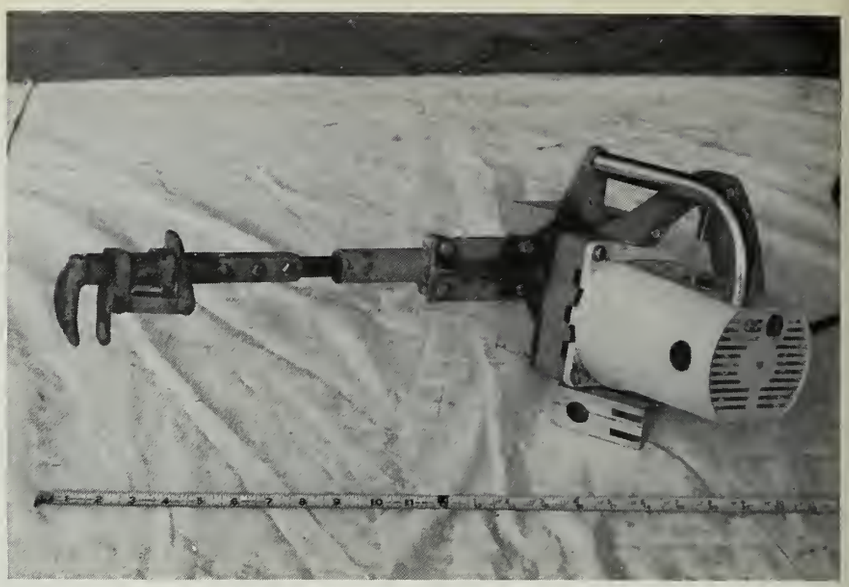
An opening in the center of the sloping platform drains snowmelt or rain into a tank housed below the surface a short distance from the gage. A concrete boundary ring with the same slope and shape as the weighing platform provides stability for the weighing system and a compensation for raindrop splash.

After the flow is collected, it is recorded by another pressure gage. When the water has reached a certain level, an automatic tripping device flushes the tank. Water in the tank is kept from freezing by a small gas pilot light.

A mechanical dual-pen recorder, connected to both pressure gages, records the rate of water collection in the underground tank and the water equivalent of snow on the platform.

In the fall of 1967, ARS soil scientist L. M. Cox and hydraulic engineer W. R. Hamon installed several of the new gages at Idaho locations where average snow depth ranged from 3 to 10 feet. Snow was meager during the 1967–68 season, and a good comparison between the new gage and the snow pillow was not possible. The limited data, however, indicate that performances were comparable.

Diameter of the gage will be increased, the scientists say, if results show a significant departure from the 12-foot snow pillow used as a standard.■



Hand-carried coffee shaker in use (PN–1738) and, at right, a high-powered chain saw with self-closing clamp (PN–1739).

Tree Shakers Help Mechanize

HAWAIIAN ORCHARDS

ONE MAN does the work of three when an experimental system for mechanically harvesting Hawaiian coffee replaces hand picking—and the savings in wages should pay for the harvesting aids in less than a year on the average 5-acre farm.

Agricultural engineers A. L. Myers of ARS and F. A. Shellenberger of the Hawaii Agricultural Experiment Station, Honolulu, designed the inexpensive, hand-carried tree shakers and auxiliary equipment which are adapted to the rugged terrain and irregular planting patterns of Hawaiian orchards.

Eventually, when cultural practices are changed, the engineers say previously designed mobile equipment (AGR. RES., February 1966, p. 14) should further reduce labor requirements in the orchards. They point out that wages for harvest labor now make up almost two-thirds of production cost.

Myers and Shellenberger adapted electric power units of commercial drills, polishers, and saws to operate shakers that vibrate coffee cherries off the trees. They designed low-, medium-, and high-powered shakers because bearing coffee trees vary in size and stiffness. A 75- to 100-foot extension cord connects the shaker to a generator in a truck or hand-carried on access roads through the closely planted trees.

A three-man crew is needed—one to operate the shaker and two to handle drop cloths on which the cherries fall, bend tall branches, and move harvested coffee to an access road. Starting at the top of the tree, the shaker is attached to successive groups of branches, removing the fruit at each location in 2 to 3 seconds. The two men on the ground, with two 12- by 15-foot drop cloths, can keep pace with the shaker operator.

The engineers also designed equipment for handling the harvested coffee.

They devised a way to transfer the coffee through a circular opening in the center of the drop cloth to a detachable sack with an elasticized top that can be attached to a metal ring around the opening. They also built a sheet-metal duct equipped with a blower that removes leaves and trash as the coffee cherries are poured through it.

In addition, the engineers designed a separator to remove immature fruit. They found that immature fruit tends to be smaller and bounces farther when dropped against a hard surface. In their separator, fruit is oriented on its side with an inclined rod conveyor and then is bounced off an angled steel plate.

If present processing equipment can be modified, the engineers say the sparator may not be needed.■

AGRISEARCH NOTES

Lilliputian Layer Project

Taking confinement-feeding and concentrated production to fantastic heights, scientists are keeping 5,000 "layers" producing about 75,000 eggs per day in a house measuring 10 by 7 feet.

The scale of the operation is lilliputian. The eggs look like grains of sugar, and the layers measure only about one-seventh of an inch from head to stern. They are red flour beetles (*Tribolium castaneum*), common pests of milled grain, and millers hate them.

To geneticists, however, beetles are friends with many traits that can be differentiated genetically. That's the reason for the large colony at Lafayette, Ind., shared by ARS geneticist S. P. Wilson of the Genetics Pioneering Research Laboratory and Purdue University geneticist A. E. Bell of the Population Genetics Institute.

For example, individual flour beetles differ considerably in larval and pupal weight. But whereas pupal weight differences are principally genetic, larval weight varies largely with environmental conditions. Such characteristics make beetles a good model for basic reproductive studies in domestic animals.

Besides permitting miniaturization of research, beetles also help compress research time. Whereas, in most cases, scientists can produce only one generation of chickens per year, they can raise 10 to 12 generations of beetles.

Furthermore, beetles are ideal for checking research results. While processing data, scientists can cool the beetles from their ideal of 91° F. down to 50.° At this temperature, the beetles can be held up to 2 years. If they need a rerun, scientists warm the beetles back up, and the original parents can be used again to check the old data with new progeny.

Hot Wash May Remove Press

High washing and drying temperature may cause a loss in both fabric smoothness and crease sharpness in durable-press cotton garments.

Preliminary research findings also indicate that the effect of drying temperature in durable-press finish is significantly less than the effect of wash water temperature.

Working at the ARS Southern utilization research laboratory, New Orleans, La., chemical engineer N. B. Knoepfler and co-workers conducted research on five representative durable press treatments applied to three different types of cotton fabric. Controlled washing and drying temperatures ranged from 122° to 176° F., the range of most household type automatic washers and driers.

In almost every combination of fabric and treatment, a dramatic change in performance occurred at

158° F. At this point, quality of the durable press finish usually took a decided turn downward. The scientists believe that some chemical change must occur in chemically modified cottons subjected to this temperature.

The decrease in performance of fabrics washed in 158° F. or hotter water was more pronounced than the decrease in performance of fabrics dried at the same temperatures. This may be because the cooling effect of evaporating moisture kept the fabrics below the experimental temperatures until the end of the drying cycle.

Although the researchers agreed that durable press performance was adversely affected in most cases, the evaluations were largely subjective and the degree to which performance was affected could not be measured accurately.

Apple Pomace Comes Back

Apple pomace—the peels, cores, and other waste from cider production—may make a comeback as beef cattle feed.

Years ago, scientists established that pomace makes excellent cattle feed (AGR. RES., May 1958, p. 3). But the increasing popularity of DDT for controlling orchard insects raised the residue level in meat from pomace-fed beef cattle far above the 7 ppm (parts per million) limit set by the Food and Drug Administration. This ended pomace feeding.

Recently, however, ARS physiologist T. S. Rumsey and Virginia cattle specialist K. P. Bovard, working at Front Royal, Va., in the heart of western Virginia's apple country, took another look at the residue problem. They were motivated by the recent switch from DDT to newer pesticides.

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many of which don't pose a residue problem for livestock.

In the most recent trial, during the winter feeding season of 1966–67, they fed commercial pomace with 0.6 ppm DDT residue to pregnant cows, alternating this feed with hay from day to day. DDT residues in the tailhead of cows and their calves never exceeded 2.2 ppm on this basis. When pomace was diluted with equal amounts of corn silage, residue levels in cows never exceeded 1.2 ppm.

Although the evidence indicates that the DDT problem could be solved practically by alternating pomace with hay or diluting it with corn silage, the pomace tested at Front Royal was still unacceptable. It contained excessive residues of Kelthane and tetradifon, pesticides sometimes used by apple growers for mite control.

Quicker Test for Feed Protein

A quicker and simpler method for determining the amount of protein in feed and forage crops is available now through dye-binding.

The need for such a method has become increasingly evident with the greater emphasis being placed on high-protein crops in the war against hunger.

ARS soil scientists A. J. MacKenzie and E. R. Perrier at Brawley, Calif., adapted dye-binding for plant analysis from methods investigated by the dairy industry for determining milk proteins.

In the new method, plant samples are dried and ground through a 40-mesh sieve and treated with an Orange G dye solution. The dye binds the basic groups of proteins and forms an insoluble dye-protein complex.

The precipitate formed is removed by filtering or centrifuging, and the optical density of the clear solution is read in a spectrophotometer, an instrument that measures color intensities of light.

Duplicate samples of various crops were determined by both the dye-binding and the Kjeldahl methods now used. Results showed a good correlation between the two, and ARS scientists believe dye-binding may supplant the current time-consuming and expensive methods.

Retaining Water in Fallow Soils

Herbicides and wheat straw mulch can be linked in the Great Plains for greater soil water storage during periods of fallow.

In ARS tests, more than 40 percent of the total precipitation received during a fallow period was saved by the herbicide-mulch; conventional tillage treatment retained only 35 percent.

Summer fallow is necessary for stable dryland crop production in the semiarid Great Plains, and as much water as possible must be stored during this period.

ARS soil scientist D. E. Smika and agronomist G. A. Wicks of the Nebraska Agricultural Experiment Station compared treatments of herbicide alone, herbicide-subtillage, and conventional tillage practices. The scientists grew a 3-year rotation of winter wheat, sorghum, and fallow as well as a 2-year rotation of winter wheat and fallow.

All treatments receiving herbicide applications retained more soil water than the conventional tillage treatment, with the all-herbicide treatment showing the largest gain. The additional gain in water storage in the all-herbicide treatment is credited to preservation of residues (straw mulch) and maximum weed control.

In the 2-year rotation, the 3-year average soil water gain during the 14½-month fallow period ranged from a low of 7.3 inches on bare soil after spring plowing to a high of 12.8 inches with the all-herbicide treatment.

Where mulch was present, soil water gain was more than 2 inches greater than with bare soil.

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.

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